HOW TO MOUNT AN EXPERIMENT: INTRODUCTION

The following instructions are provided for mounting the Space Experiment Module (SEM) student experiment on the National Aeronautics and Space Administration (NASA) supplied Experiment Mounting Plate.

Experiment mounting requires that the experimenter locate and drill the experiment attachment holes on the Experiment Mounting Plate. The experimenter then attaches the experiment to the Experiment Mounting Plate using NASA supplied hardware and the instructions provided in this document.

Figure 1 illustrates how the experiment fits within the NASA Space Experiment Module. Figure 2 details the Experiment Mounting Plate; the continuous white line on the inner surface of the plate delineates the experiment envelope. It is the experimenters responsibility to ensure that all experiment components are located within the allotted experiment envelope and that any attachment holes drilled through the mounting plate are filled using the sealing washers and screws provided. This is required to guarantee that the integrated experiment fits within and provides a sealed cover for the SEM container.

Prior to integrating the experiment, read through this entire document. Any questions may be directed to:

Shuttle Small Payloads Project (SSPP) at NASA Wallops Flight Facility (WFF)
Phone: (757) 824 - 1732
Fax : (757) 824 - 1694
Regarding: SPACE EXPERIMENT MODULES

HOW TO MOUNT AN EXPERIMENT: MOUNTING PROCESS

Required Items:

National Aeronautics and Space Administration (NASA) supplied Experimenter supplied

- "How To Mount a Student Experiment"
- experiment apparatus
- Experiment Mounting Plate
- clamping equipment
- panhead screws (size #6-32)
- drill
- sealing washers (size #6)
- drill bit (size #25)
- self locking nuts (size #6-32)
- screwdriver (Phillips head)
- wrench (3/16 inch or adjustable)
- torque wrench and 3/16 in. adapter
- fastener lubricant (see section 2.2.4)
- hole center punch or transfer punch (size #25) and hammer (as required)
- hole template (as required)
- micrometer or equivalent measurement device

Mounting Procedure:

Brace Mounting Plate:

It is recommended that the Mounting Plate be clamped or otherwise secured to a firm structure to brace the plate during the drilling process.

Check experiment positioning:

Position the experiment apparatus on the inner surface of the Mounting Plate. The inner surface is identified by the printed outline and marking "EXPERIMENT ENVELOPE". Verify that no portion of the experiment extends beyond the printed outline or more than 3.0 inches perpendicular from the inner surface of the plate.

Drill attachment holes:

A variety of methods can be used for locating and drilling the experiment attachment holes on the Mounting Plate. The best method for a given experiment depends on whether or not the attachment holes are already present in experiment hardware and on the design of the experiment at the Mounting Plate interface.

• If the attachment holes are not already present in the experiment hardware: Match Drill method may be used to drill the experiment and mounting plate attachment holes simultaneously. This method is suitable for designs where the attachment holes do not yet exist in the experiment hardware. Match Drilling has the least probability of error and is recommended whenever the interface design has enough clearance to accommodate the drill.
• If the attachment holes are not already present in the experiment hardware: The Punch Marking method is done using a hammer and a transfer punch to dimple the attachment hole locations on the Mounting Plate using existing attachment holes in the experiment as guides. Punch Marking is suitable for designs where the attachment holes in the experiment are already present.
• The template method: Attachment interfaces designed with limited access for drilling and punching tools may require an interface Hole Template. In this case the experimenter must fabricate a template of the interface hole pattern and use it on all parts to be integrated. If the attachment holes in the experiment hardware do not yet exist, the template may be used to dimple the hole locations on the experiment hardware as well as on the Mounting Plate. If the attachment holes are already present in the experiment hardware, these holes can be used as guides to make the template.
The three methods outlined above for siting and drilling the attachment holes on the Mounting Plate are described below in detail. In all methods, care must be taken to assure that the holes are accurately located and drilled at a right angle to the Mounting Plate surface.

Match Drill method (recommended): After positioning (step 2.2.2 above), clamp the experiment to the Mounting Plate so that it will not move during drilling. Mark the designed attachment hole locations on the clamped hardware . After marking, dimple these locations by using a hammer to lightly tap a center punch at the marked locations. Assuming there is sufficient drill clearance, drill through the experiment and Mounting Plate with the same motion, using the dimples to guide the tip of the drill bit. Drill holes are to be .149 inch diameter or a #25 drill bit may be used.

Punch Marking method: After positioning (step 2.2.2 above), clamp the experiment to the Mounting Plate so that it will not move during punching and drilling. Assuming that the attachment holes are already present in the experiment structure, insert a #25 transfer punch through each hole and use a hammer to tap the transfer punch with sufficient force to indent the Mounting Plate. The

punch should leave a dimple that marks the center location of each hole. Do not unclamp the experiment until all of the attachment holes have been punched. Unclamp the experiment and drill through the Mounting Plate using the dimple to guide the tip of the drill bit. Drill holes are to be .149 inch diameter or a #25 drill bit may be used.

Hole Template method: This method requires that the experimenter construct an attachment hole template before drilling the attachment holes. The template is a sheet of aluminum with the attachment hole pattern drilled into it. The template will be clamped or otherwise secured to the Mounting plate so that the attachment hole pattern is positioned as designed with respect to the Mounting Plate. The attachment hole locations will then be dimpled into the Mounting Plate using the template holes as guides for transfer punching. The Mounting Plate is then ready for drilling of the attachment holes. The same template and procedure could also be used to drill the attachment holes into the experiment.

The template should be constructed of .125 - .250 inch thick aluminum sheet and must be of adequate size to capture the entire attachment hole pattern on one integral piece. To make the template, first lightly spray the aluminum sheet with white paint so that the markings for the attachment hole pattern will be more easily seen.

If the template is to be used for attachment hole drilling on both the experiment and the mounting plate, use a micrometer and a pencil to locate and mark the designed locations of the attachment hole centerlines on the painted sheet. After marking, dimple these locations by using a hammer to lightly tap a center punch at the marked locations.

If the attachment holes already exist in the experiment, clamp the experiment to the painted sheet and use these existing holes as guides to dimple the corresponding hole locations onto the painted sheet. Insert a #25 transfer punch into the existing holes and lightly tapping the punch with a hammer. If there is not enough access for a transfer punch, insert a piece of lead from a mechanical pencil through the existing holes to mark the hole locations. After marking, dimple these locations by using a hammer to lightly tap a center punch at the marked locations. Do not unclamp the experiment until all of the attachment holes have been dimpled onto the painted sheet.

After all of the attachment hole centers have been dimpled onto the sheet, remove the clamp and drill through at each location using the dimple to guide the tip of the drill bit. Drill holes are to be .149 inch diameter or a #25 drill bit may be used. Since the template material is relatively thick, it is very important that the holes are drilled perpendicular to the surface.

After drilling, position the template and experiment together and check for proper hole alignment; if adjustments are required, construct another template and repeat the above process before drilling into the Mounting Plate.

When an accurate template has been constructed, clamp the template to the Mounting Plate so that the attachment hole pattern is positioned as designed. Dimple the corresponding hole locations onto the Mounting Plate by inserting a #25 transfer punch into the template holes and lightly tapping the punch with a hammer. After all of the attachment holes have been dimpled onto the Mounting Plate, remove the clamp and drill through at each location using the dimple to guide the tip of the drill bit. Drill holes are to be .149 inch diameter or a #25 drill bit may be used. The same template and procedure may be used to drill the attachment holes into the experiment.

Lubricate fasteners:

Apply a small amount of one of the lubricants listed below to all screw threads and wipe off excess with a lint free cloth:

Lubricant Suggested source of supply:

Apiezon L Biddle Instruments
510 Township Line Road,
Blue Bell, Pennsylvania 19422

Braycote Burmah-Castrol, Incorporated.
Bray Products division
2698 White Road, Irvine, California 92714

Attach experiment:

Align the attachment holes on the experiment structure with the corresponding holes on the NASA Mounting Plate. Place one sealing washer on each screw shaft. Connect the experiment to the Mounting Plate by inserting the screw/washer assemblies through all of the mounting holes so that the screw head is on the outer surface of the mounting plate and the screw shaft extends through the experiment with at least .16 inches of shaft length protruding for the nut attachment. Place one flat washer on each protruding shaft and attach the locking nuts until they are "snug - tight". If possible, do not remove the locking nuts once they have been screwed on; the locking feature, which prevents the nut from "backing off" during the vibrations of Shuttle launch and landing, degrades each time the nut is removed.

Torque the nut:

When all of the nuts have been turned to the "snug - tight" position, the interface joints must be preloaded by torquing the nuts to a value of 5 inch-pounds. This may be measured by using the gauge on a torque wrench.

Bonding Technique:

While the adhesive is excellent for bonding rubber, metal, wood, and most plastics, it may not be suitable for use with other materials. Inquiries regarding the suitability of specific materials for use with the adhesive may be addressed to the manufacturer's technical support representative at:

Minnesota Mining & Manufacturing Company, St. Paul, MN.
Adhesives, Coatings, and Sealers Division
Technical Information Assistance for Scotch-Weld DP - 190 Gray Epoxy Adhesive
phone: 1-800-362- 3550
TBD